

BIMETALLIC DIFFUSION MEMBRANES: POSSIBLE USE FOR ACTIVE HYDROGEN RECYCLING CONTROL

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The bimetallic diffusion membranes, which consist of a rather thick (0.1-0.5 mm) Pd-substrate and thin (1-10 μm) film deposited on its surface, could be very convenient for an active control of a hydrogen isotope density near plasma facing surfaces [1]. In the case of hydrogen recycling control such membranes can provide different regimes: with high recycling coefficient (gas puffing through membrane) and with low recycling coefficient (hydrogen pumping by membrane).

In this study the hydrogen permeation performances are analysed for micron Mo, Ti, Nb, Zr, Cr, Ni, Cu, CuPd, TiN, and stainless steel films deposited on palladium from arc sputtered cathodes. Some physical mechanisms explaining anomalies behavior in above mentioned systems are discussed.

The activation energies of permeability for most studied films are in a few times lower than the literature data for the bulky metals. This is due to a high porosity of films which caused by a big difference between substrate temperature (570K) and melting of most deposited metals [2]. In such situation the hydrogen permeability of Mo-film can be, for example, more higher than that for Ti or Ni, in spite of the fact, that in the hydrogen permeability row of metals Mo is in far position in back of Ti and Ni (on the literature data base one can suggest such row from high to low hydrogen permeation - Ti, V, Zr, Nb, Ta, Fe, Ni, steel, stainless steel, Co, Cr, Al, Cu, Mo, Ag, Pt, W) . This fact is explained in the frame of model of anomalies diffusion in the system with the net of connected pores , when hydrogen diffusion coefficient increases in two orders of value [3]. Such phenomenon could be used for creation of erosion high resistible component with the use of diffusion membrane coated by erosion high resistance material. The possible model of such component is given. The palladium (Ag-Pd alloys) is the unique material, which can provide high hydrogen isotope concentration and high hydrogen flows to/through protective layer. A potential barrier on the boundary between film and Pd-substrate might be easily overcome because hydrogen in palladium is in atomized or ionized state, similar to plasma state [4]. So, even films with the high-energy hydrogen coupling are not resistible for hydrogen penetration from Pd . It must be noted that not only metal films could be applied in such scheme but nonmetal material too, e.g., carbon, carbides, nitrides, etc. The use of the diffusion membranes coated by erosion high resistible material could be as a perspective variant for plasma facing components providing both erosion and active hydrogen recycling processes control.

In the frame of non-ideal plasma theory the mechanism is suggested of hydrogen high content (clusters) formation as the result of hydrogen plasma phase transitions in metals.

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